

# Creating a Virtual Community of Learning Predicated on Medical Student Learning Styles

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*To create a virtual community of learning within the Indiana University School of Medicine, learning tools were developed within ANGEL to meet the learning needs and habits of the medical students. **Methods:** Determined by student feedback, the integration of digital audio recordings of class lectures into the course management content with several possible outputs was paramount. The other components included electronic enhancement of old exams and providing case-based tutorials within the ANGEL framework. **Results:** Students are using the curriculum management system more. Faculty feel more secure about their intellectual property because of the authentication and security offered through the ANGEL system. The technology applications were comparatively easy to create and manage. The return on investment, particularly for the digital audio recording component, has been substantial. **Conclusion:** By considering student learning styles, extant curriculum management systems can be enhanced to facilitate student learning within an electronic environment.*

## BACKGROUND AND SIGNIFICANCE

Medical education from the early 1950's until recently was based in large part on rote memorization of facts driven by the objective assessment measures of the National Board of Medical Examiners.<sup>1</sup> Medical students have been recruited based on their GPA, particularly in science courses, and their MCAT scores, a demonstration of their knowledge at the point of testing rather than their ability for continuous learning.

In the late 1980's, with the medical knowledge explosion, educators began questioning the need to teach more and more basic science facts in favor of a curriculum with more clinical relevance. At the same time, national licensure exams were beginning to reflect the changes in emphasis in medical education.<sup>2-3</sup>

However, most basic science and clinical faculty still taught facts to insure that their students passed the national exams.

Rather than the standard emphasis on the teaching and regurgitation of facts, common in the last half of the 20<sup>th</sup> century, some medical educators began introducing a new form of medical education, problem-based learning [PBL], more closely aligned with adult learning styles.<sup>4</sup> Studies on this new education form found greater appreciation and less student distress in the new mode of learning.<sup>5-6</sup>

For many of those schools opting to continue traditional forms of medical education, computer assisted instruction [CAI] began in the 1960's as a means to facilitate teaching the growing factual knowledgebase of medicine. Early programs were initially designed to mitigate need for classroom instruction or to teach problem-solving skills in clinical medicine.<sup>7</sup> By the 1980's, computer assisted instruction was still being used, but as an adjunct to classroom instruction.

With the advent of curriculum management systems and their rapid adoption by medical schools, CAI entered into a new era. For the first time, medical education had the ability to facilitate student learning on-demand, within an environment and at a time chosen by the student. Schools had the opportunity to use these systems to facilitate student learning by incorporating the principals of adult learning theory and the differences in learning styles. However, most schools used the new tools to offer greater access to more knowledge through electronically distributed syllabi and supplemental materials, e-reserves and e-texts.

In 2000, the Indiana University School of Medicine [IUSM] adopted ANGEL [A New Global Environment for Learning], developed by CyberLearning Labs, Inc., as its curriculum management system [CMS]. The choice over other curriculum management software on the market at the time was based on the number of features that were specifically designed for medical education. Within the first eighteen months of use, every undergraduate medical education course on the Indianapolis campus used ANGEL for at least access to syllabi, instructor notes, and knowledge-based resources. Most of the graduate medical education courses used the system, sev-

eral for tracking graduate competencies, some for scheduling and communication and others for evaluation. Every student was required to use the system, but, according to computer logs, only half of the students used it routinely.

Through convenience sampling of medical students to determine the reasons for the lack of wide spread use, several themes emerged. Chief among these was the impression that ANGEL did not address the specific modes of learning preferences by the students. Specifically, during the freshman and sophomore years, students with the least pervasive adoption of ANGEL relied primarily on the audio tapes of classes for reinforced learning as well as old assessment instruments and small group, case-based learning exercises conducted both within and outside of the classes.

### AIMS

In an attempt to increase student use of ANGEL predicated on learning styles and addressing student stated needs and to create a virtual community of learning within the electronic environment, system reengineering through introduction of student driven enhancements was undertaken:

- To provide medical students with a variety of class presentation resources within the ANGEL system
- To facilitate multiple means by which students can access and use these resources
- To ensure anywhere, anytime access to these resources
- To provide these resources in a secure virtual environment using appropriate authentication tools

### METHODS

Before discussing enhancements it is necessary to understand the functionality of the extant curriculum management system. Although ANGEL was originally designed to fully address the needs of distance learning programs, it offers an automated method of creating a complementary Web environment for every traditional classroom-based course in an academic medical center. Additionally, ANGEL offers an enterprise solution for the creation of a complete institutional portal for e-learning that that can be accessed using a single user name and password authenticated through the university's global directory services. While other institutionally based systems exist to support their own medical education activities,<sup>8</sup> ANGEL as a CMS is exceptional in that, as a commercial product, it was developed to address

the specific scheduling and multi-level faculty constructs unique in medical education.

The features of this system include:

- Automatic creation of a user profile or Website for every user (students, faculty and staff)
  - Automatic creation of a personalized calendar, bookmarks, task lists and more for every user and every course
  - Automatic creation of a Web environment for every course offered, including both distance learning and traditional classroom-based course sections
  - On-demand creation of group Web environments for both personal and public groups
  - Automatic maintenance of a series of school-wide resources including a Web-based classifieds page, news bulletins, message boards, and smart search engines
- Automatic creation of Web-server accounts for every user
- Automatic creation of a single "front door" URL and one-time authentication for above services
  - Automation of time consuming and repetitive tasks through the use of integrated intelligent agents

The entire ANGEL application consists of a series of Active Server Pages (ASP) that access a number of custom components which store and retrieve data from a MS SQL Server database or other ODBC-compliant data source. Each of the ANGEL components is built as a separate Active X Dynamically Linked Library (DLL). The DLL files were created in Visual Basic 6 Service Pack 4. Style elements such as fonts and color schemes are controlled using Cascading Style Sheets (CSS) to allow maximum flexibility in the presentation of information without requiring source code modifications or advanced ASP scripting.

With its adaptive interface, ANGEL offers a platform for community building in addition to course delivery. The component-based architecture has allowed the School of Medicine to customize its features and appearance for its own audiences. All of the major CMS features are included: chat rooms, threaded discussion forums, mail messaging, quizzes, surveys, homework submission and file upload capabilities. However, with all of this functionality and basic architecture for creating a virtual community of learning, the students wanted more, or at least a different presentation of learning tools within the ANGEL environment.

## **Auditory Learning**

The most demanded enhancement addressed the need to provide audio access to all basic science lectures in a variety of formats and selected access to lectures in video format. For over twenty years Indiana University School of Medicine had been audio-taping all basic science classes and loaning the tapes, on demand, to medical students enrolled in the respective classes. The average use required producing two to three tapes per class. The need to move to a digital delivery method was further exacerbated by the increasing demand for audiotapes by the class of 2006, up to ten tapes per lecture, and the loss of personnel in the unit that had been providing this service.

Audio/video streaming was the obvious solution but there were a number of problems. All students were required to buy computers and have Internet access. A campus modem pool provides off-campus access for this purpose. However, based on local phone service, connection speed could be as low as 19.2 kbps, precluding streaming audio and video signals as the only means of access. In addition, many students enjoyed the ability to take tapes on vacation or listen while in the car. Another issue involved the appropriate way to offer the audio through ANGEL. The simpler solution would be to provide an index and direct access to a media server, such as Standord's MediaServer.<sup>9</sup> However, that would mitigate the goal to create the virtual community of learning within the ANGEL framework.

To address the student access issue, a solution was employed that enabled audio streaming as well as downloading to MP3 players and decompressing the audio for CD creation. To address the issue of integration within the ANGEL environment, the lectures are recorded digitally and captured in time sequenced segments. These are then encoded and linked to the appropriate classes within the ANGEL system.

The system architecture is composed of a three line feed from three classrooms/auditoriums in two separate buildings. The digital microphones are multi-purpose and can amplify voice in the classrooms/auditoriums as well as capture the audio for transmission. During the first three months of implementation, a decision was made to provide redundancy by creating audiotapes as backup. Therefore, the signal was split two ways, one going to an audio cassette tape deck and the other to a Dell workstation with an audio card. For simultaneous feeds, three workstations and three cassette tape decks were used.

The Dell workstations run Windows XP professional, and the encoder software is AudioGrabber.<sup>10</sup> Although many MP3 encoding packages were considered, AudioGrabber was chosen because of its

scheduling capabilities. Each evening the staff responsible for the audio capture must setup the recording jobs to run the next day. For each daily schedule, the audio is captured without staff intervention. There is currently no way to setup recurring jobs on multiple days.

The audio is saved to a local file on the Dell encoding stations. After the recording is complete, the file is manually moved to a shared folder on the media server. The staff involved with the audio capture have authority to copy files into this folder, but not to delete or overwrite any other files.

Once the file is on the media server, it is immediately available to students through the ANGEL system. There is a Java program that parses the media server for MP3 audio, and creates download and stream links for output to a web browser.

There was some discussion by faculty about the best way to make the audio files available. Because the Indiana University School of Medicine has multiple campuses for freshman and sophomore years, some faculty wanted the files to be indexed within Angel and made available to all students at all campuses, insuring that all students had equal access to teaching on the Indianapolis campus. However, other faculty wanted the digital audio recordings of each class to be linked to the specific class, letting the faculty member decide who did or did not have access to the lecture outside of the class.

The technology issues with the two options centered on authentication. If the digital audio recordings were linked within specific classes and courses, then only those enrolled in the courses could have access. If the files were accessible within a generic school directory in ANGEL, then any authenticated user of ANGEL could have access.

Because faculty had agreed that their classes could be audio taped and stored for the length of the semester in the Learning Resources Center, for access by the students enrolled in the respective courses, a decision was made to link each digital audio recording directly to the class, based on digital time and date stamps, within the course that it was presented. This decision was further supported because of the ability of students to access the digital audio recordings while viewing the power point slides used in the same lectures. Using the ability to schedule the recordings, the linking of the digital audio recordings is accomplished at the time the parsing takes place.

Video streaming of guest lectures is another feature of the attempt to promote ANGEL as a virtual learning community. Some faculty require students to attend named lectureships that frequently conflict with clinic or other duties. By digitally capturing

these lectures and making them available through ANGEL, an increasing number of junior and senior medical students are coming to ANGEL as their primary means to access lectures given on the medical school campus.

### **Visual Learning**

The remaining two student requested components were technologically simple, specifically providing older assessment tools within the ANGEL environment and promoting the development of case-based learning modules that would include both formative and summative assessment.

To accomplish the first, faculty were helped to reformat old tests into ANGEL's sophisticated evaluation tools. These exams, using a variety of question types, could be enhanced by limiting access to answers or providing immediate feedback with commentary on each question. The major impediment was convincing the faculty that access could be restricted to those in the class.

The second area, creation of case-based modules, was more difficult. The request for case-based tutorials has been growing with several clinical department initiatives targeting both junior and senior medical students as well as offering graduate medical education alternatives to acquire and demonstrate proof of competencies. ANGEL did not readily offer a problem-based learning tool, but by modifying the survey tool, case-based learning modules could be created. However, a prior decision had been made that while ANGEL needed to be the front end to all educational programs, any computer assisted instructional module that offered seamless interface could be incorporated into the platform.

The technology modifications for the enhancement were centered on integrating ANGEL with a system called EDACTIC [a technology suite used to create and deliver interactive coursework] as well as providing authentication that crossed both. The technical requirements to accomplish this were relatively easy because both used Microsoft authentication and management tools. EDACTIC, developed by a faculty member at IUSM, was chosen because of the relative sophistication of its case-based learning and moderately intuitive authoring tools, as well as the ability to use EDACTIC's formative assessment features combined with ANGEL's summative evaluation tools.

By listening to students and using essentially off-the-self technology, ANGEL is being transformed into an accepted virtual community of learning.

## **RESULTS**

There are several measures of success that have been used to determine the efficacy of this initiative.

These include the ability to use the extant technology as a low-cost solution to realize the aims, the acceptance of the applications by the students, and the potential for return-on-investment for the various components.

ANGEL already provides a system that supports distributed learning in a secure environment. Inherent in this is the assumption that access is anywhere, anytime. The issues raised by the students regarded the ability to get digital audio recordings of classes quickly and in a variety of formats, the ability to access old assessment tools, and the ability to use case-based computer assisted instructional modules to facilitate individual learning on-demand.

The major initiative in the attempt to move ANGEL into more of a community of learning based on different learning styles of students was the attempt to integrate auditory learning through the integration of digital audio recordings into the ANGEL system. The technology has been explained above. In a survey of other medical schools in Spring 2002, with a response rate of greater than 90%, fewer than 5% of the respondents offered comprehensive audio or video recordings of classes. Only two offered their recordings through audio streaming, and neither embedded the digital audio recordings of individual classes in their curriculum management systems linked to the specific classes.<sup>11</sup>

Student use of the three modes of access, audio streaming, downloading to MP3 players, and decompressing the audio to create CDs, is growing. Within the first few weeks of implementation, there was a 100% increase in use. While it has as yet to be determined what format will be the most popular, more students seem to prefer the creation of CD ROMs. Through random queries, many of the students report that it is easier to run their CD ROM players while viewing the PowerPoint slides and accessing other learning support utilities on ANGEL. It is assumed that more students making copies will result in more students using ANGEL for review.

In terms of return on investment, the cost of the system was \$12,365 for hardware and software, with the majority supporting the media server. Personnel costs were calculated to be \$192 based on four hours of effort for wiring @ \$22.15 per hour and six hours of effort for hardware setup and coding @ \$17.30 per hour. However, with a class size of 140 for each of the first two years on the Indianapolis campus and with the need to record approximately 1,170 freshman and sophomore lectures per year, the savings have been substantial.

The cost of audio cassettes was approximately \$9,000 per year. Although some were reusable, a substantial number were lost. The audio taping procedure required two .5 FTE personnel five days a

week to insure that the taping of each lecture was made according to a certain time schedule and that duplicate cassettes were produced. Currently, less than one .5 FTE is required to manage the entire system, including student support, and that should decrease over time with students becoming more and more familiar with downloading the digital audio recordings. The total annual cost savings without amortizing the equipment is estimated to be approximately \$24,500 for the first year. For the second year of operation, the savings should rise to over \$37,000.

Since the reformatting of the paper-based assessment tools into the ANGEL evaluation system, students have been provided with greater access and faculty are comfortable with the decision because of the security measures in place within ANGEL. However, there is one problem from the faculty perspective that still remains. Just as it is easy to copy a borrowed test, it is also easy to do a screen capture of any of the assessment tools and print it off. On the other hand, because of the functionality of the ANGEL evaluation system and the ability to either mask the right answer or have immediate feedback, it is hoped that the students using the system will not try to disseminate the content. The reformatting of the paper-based assessment tools was done within the current ANGEL environment and required no technology enhancement. The only costs involved were those of staff inputting the questions.

With the integration of EDACTIC into the ANGEL environment there has been significant positive feedback on the part of residents because of the ability to learn at home and not be subject to the new hours on site rules by the ACGME [American Council of Graduate Medical Education]. The clinicians using EDACTIC to create case-based learning have found it extremely easy to use and students using the modules have expressed that it contributes to their learning and offers them a means to interact with others in a problem-solving way in addition to helping them understanding specific clinical problems and their management. The costs for integration involved a minimal amount of information technology staff time.

## CONCLUSION

Computer assisted instruction and course management software are beginning to coalesce to provide a unique platform for on-demand learning. These systems, when combined with the principles of adult learning theory, including reliance on student learning styles and provision of experiential learning, promise to revolutionize medical education as we know it.

The Indiana University School of Medicine implemented a curriculum management system in 2000, and, like many other medical schools, its use by medical students was not widespread. Only by seeking ways to create learning environments that address student learning styles and stated needs will medical students begin to rely on these systems as virtual communities of learning. Only when medical students find comfort in working within these virtual communities of learning will they be ready to easily move into the virtual communities of medical care within the next decade.

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